No. 746,346. PATENTED DEC. 8, 1903.

L. J. J. B. LE ROND.

ROTARY ENGINE.

APPLICATION FILED MAY 26, 1899.

NO MODEL. 5 SHEETS—SHEET 1.

FIG.1.

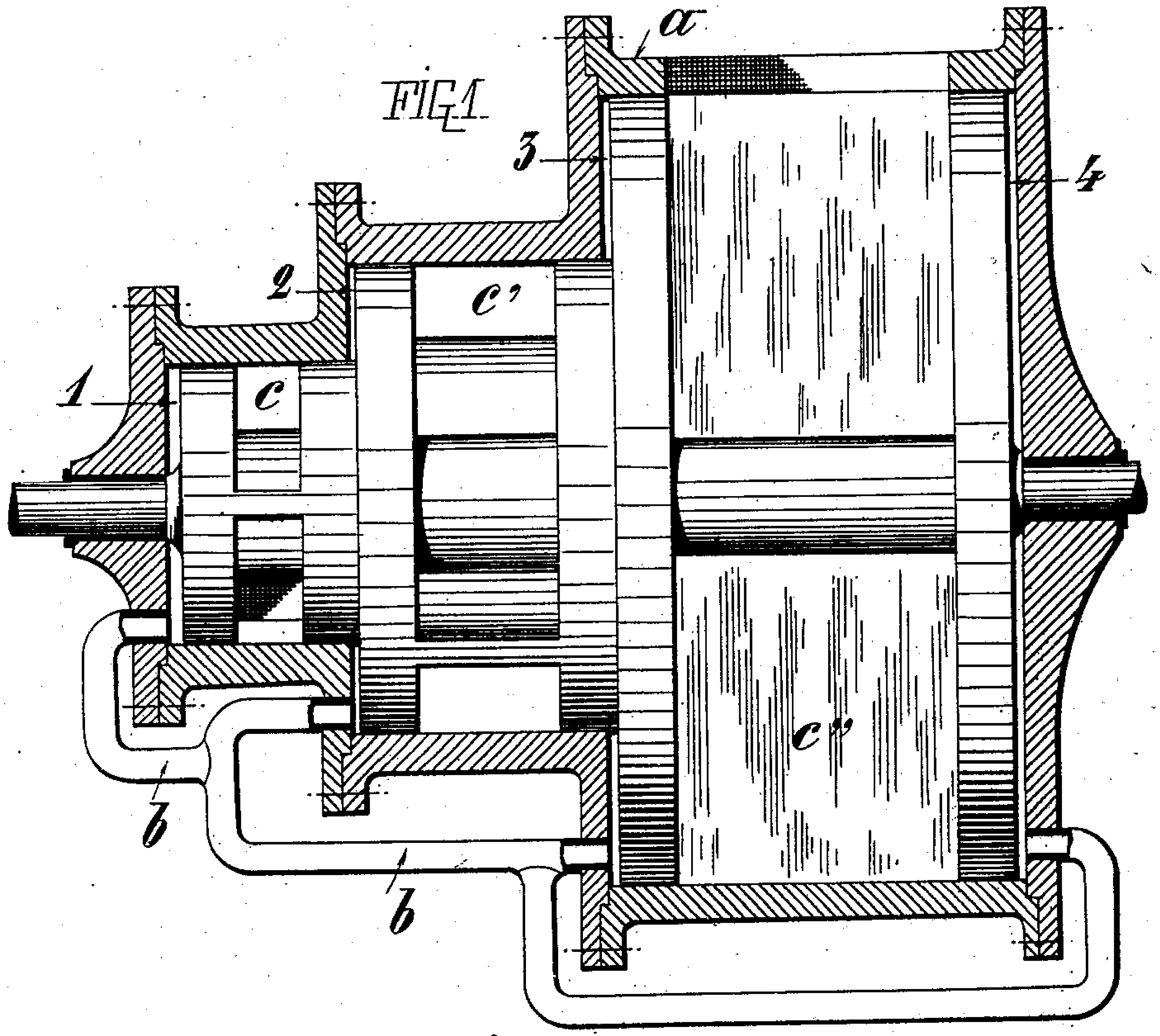
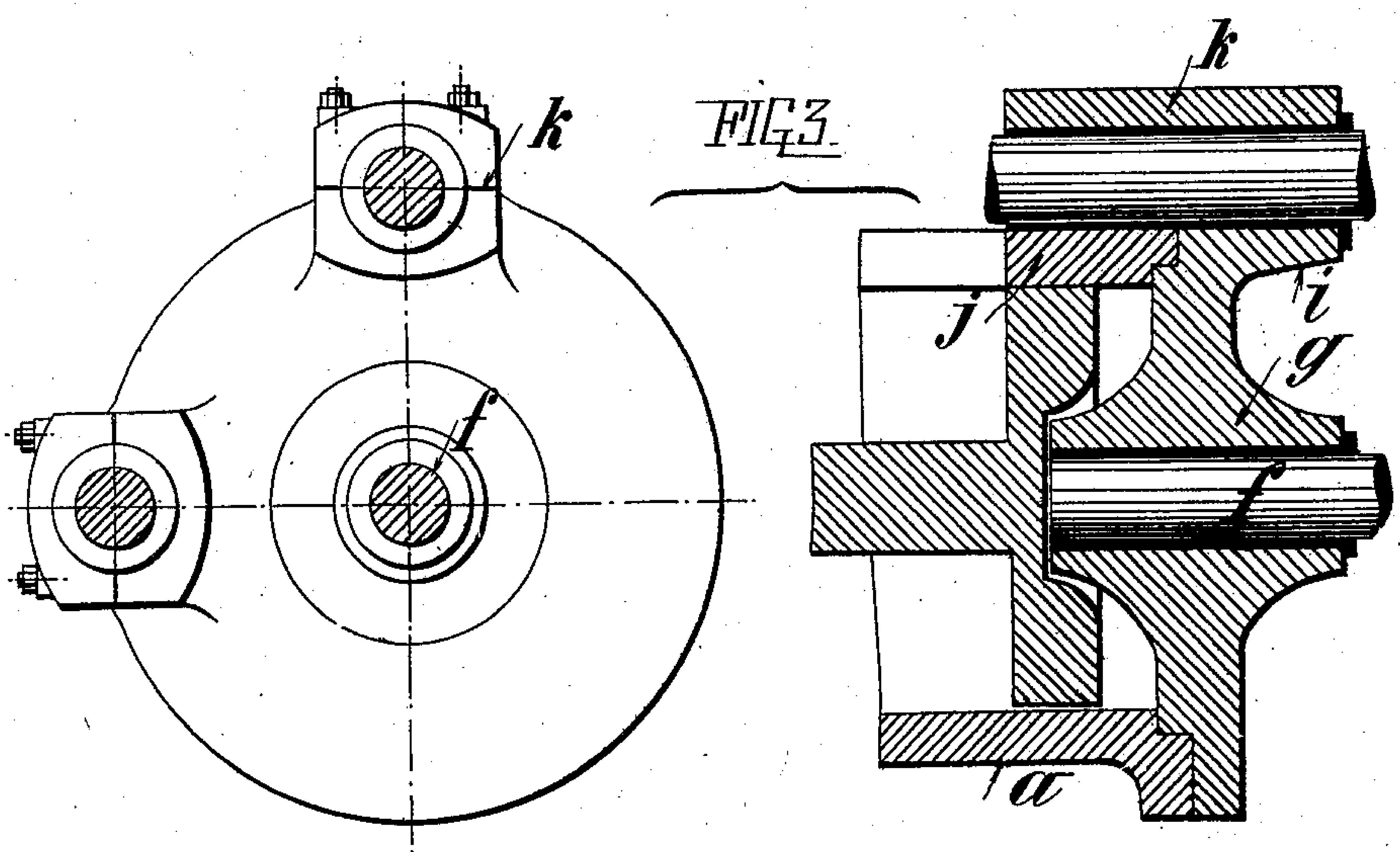



FIG.3.




WITNESSES:

[signature]

W. R. Edelen

INVENTOR

Louis J. J. B. Le Rond

BY

Philip Mauro

his ATTORNEY.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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ROTARY ENGINE.

APPLICATION FILED MAY 26, 1899.

NO MODEL. 5 SHEETS—SHEET 2.

FIG. 2.

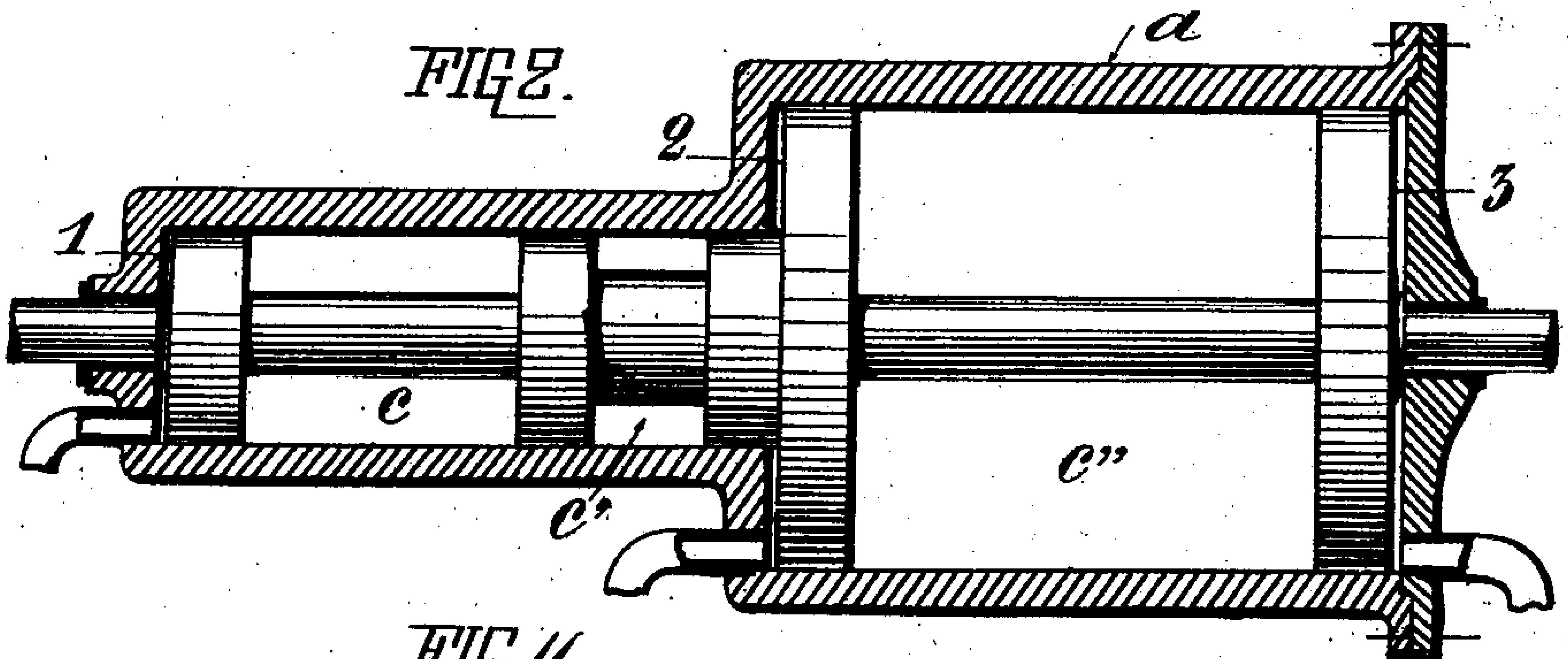



FIG. 4.

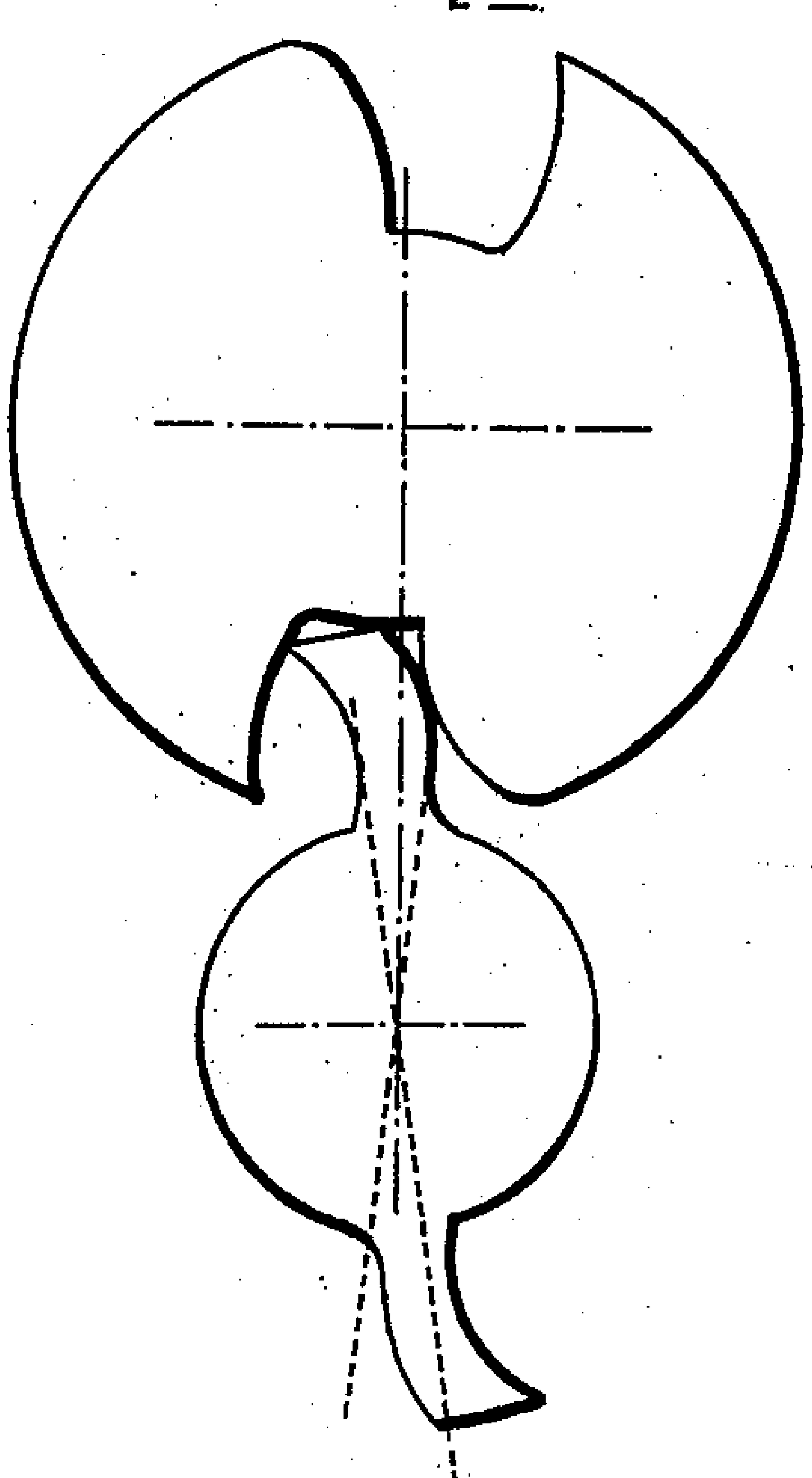


FIG. 6.

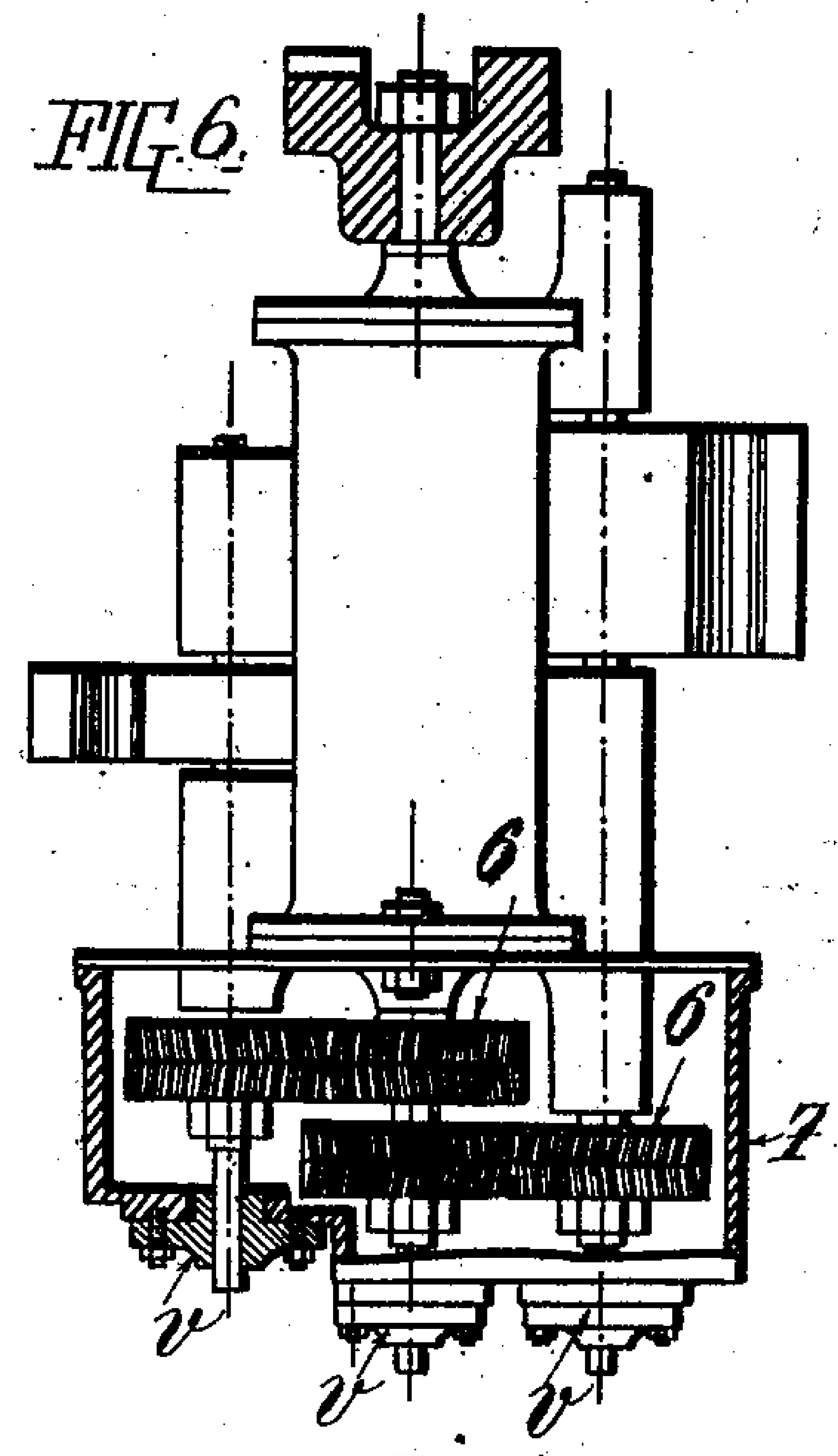
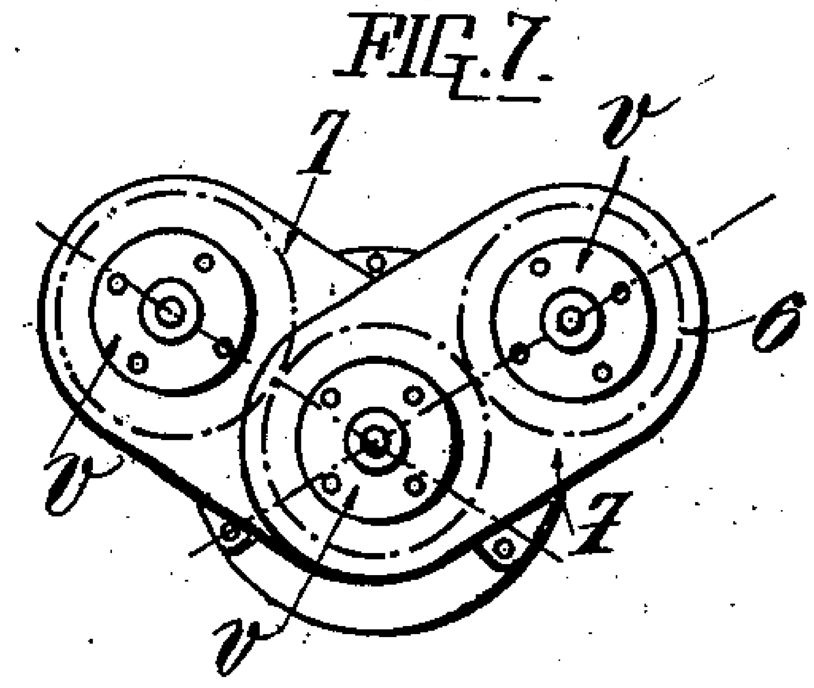



FIG. 7.




WITNESSES:

W R Edelen

INVENTOR

Louis J. J. B. Le Rond

BY

Philipp Mauro

his ATTORNEY

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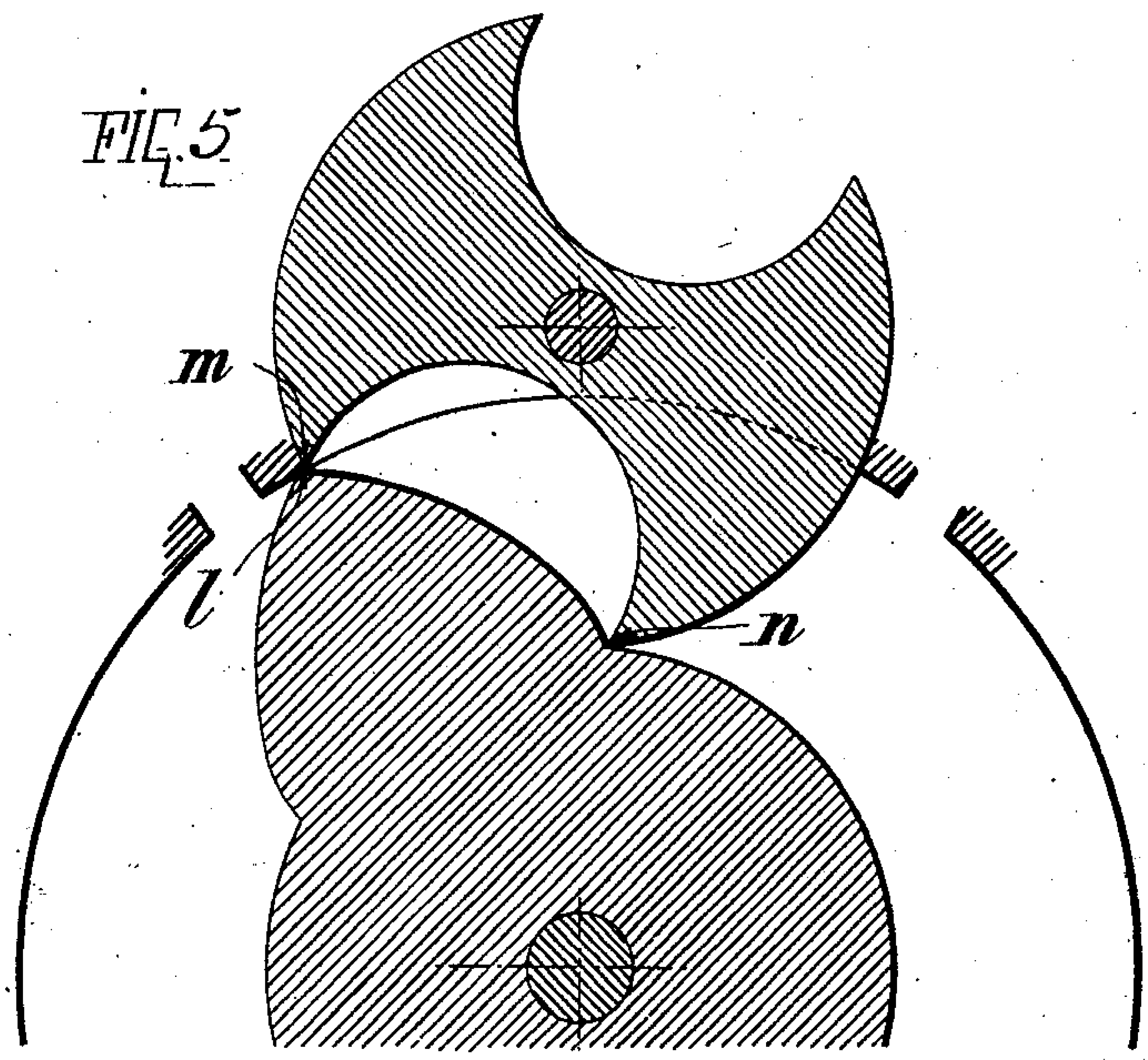
APPLICATION FILED MAY 26, 1899.

NO MODEL.

5 SHEETS—SHEET 3.

FIG. 5




WITNESSES:

Geo. Lewis

W. R. Edelen

INVENTOR

Louis J. J. B. Le Rond

BY

Philipp Hauss

his ATTORNEY.

No. 746,346. PATENTED DEC. 8, 1903.

L. J. J. B. LE ROND.

ROTARY ENGINE.

APPLICATION FILED MAY 26, 1899.

NO MODEL. 5 SHEETS—SHEET 4.

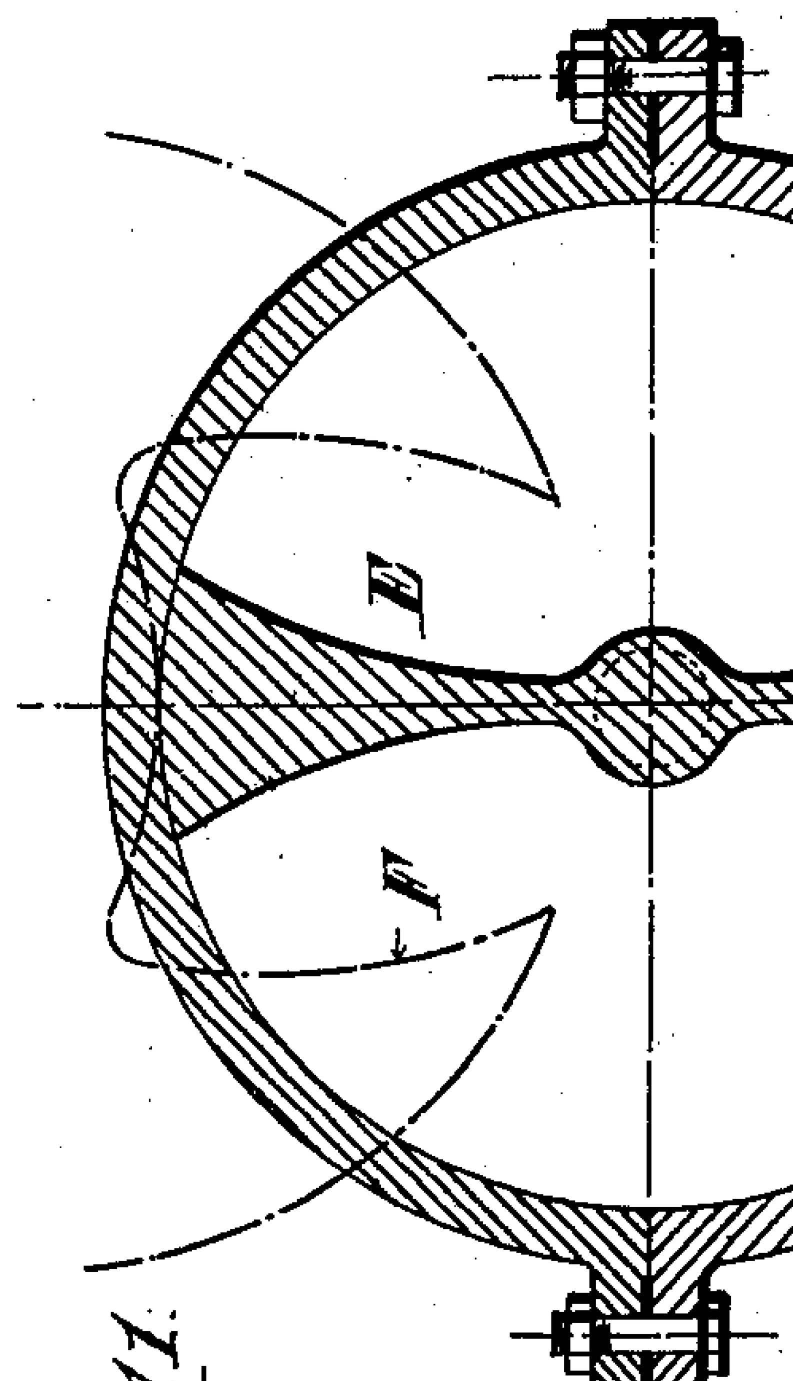



FIG. 11.

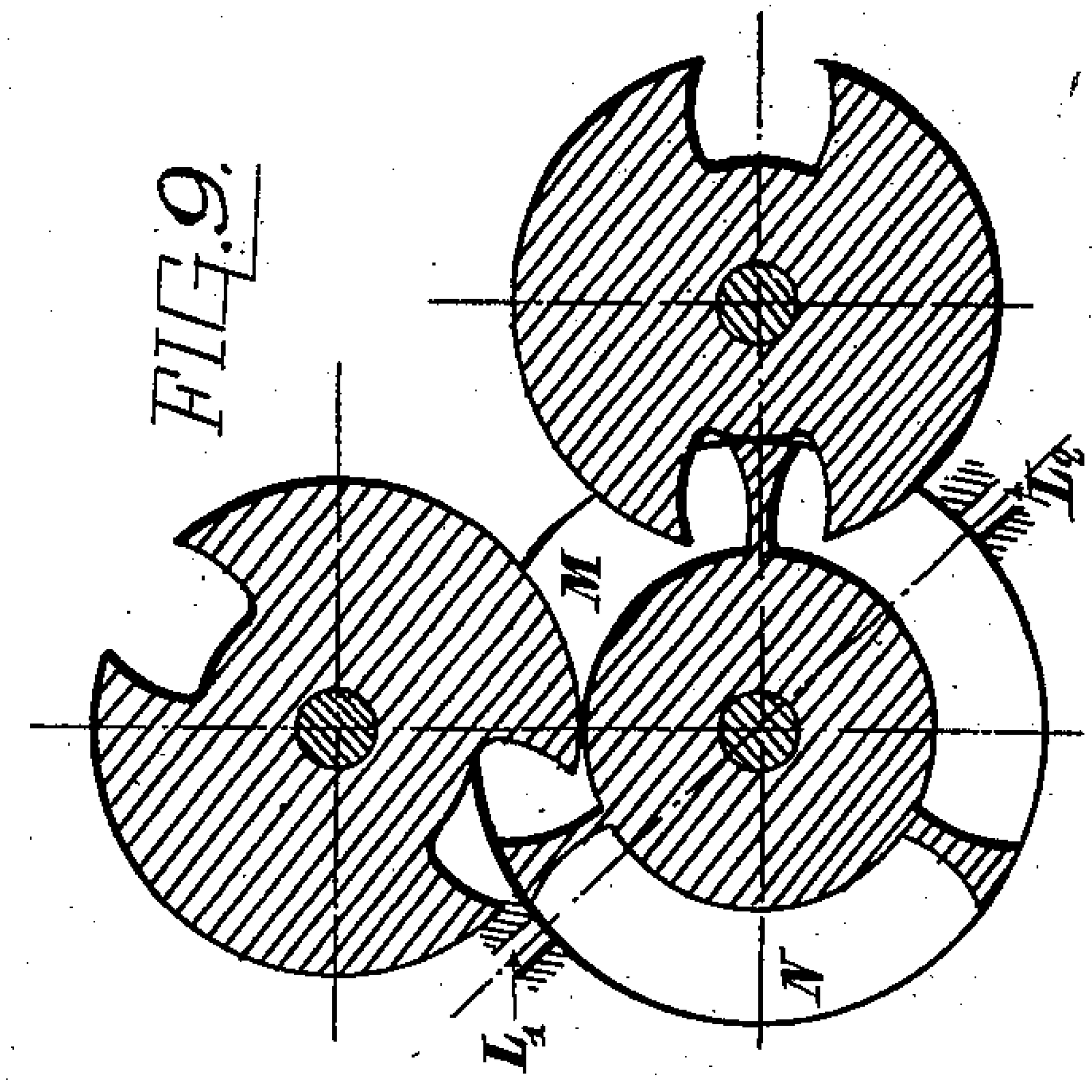



FIG. 9.

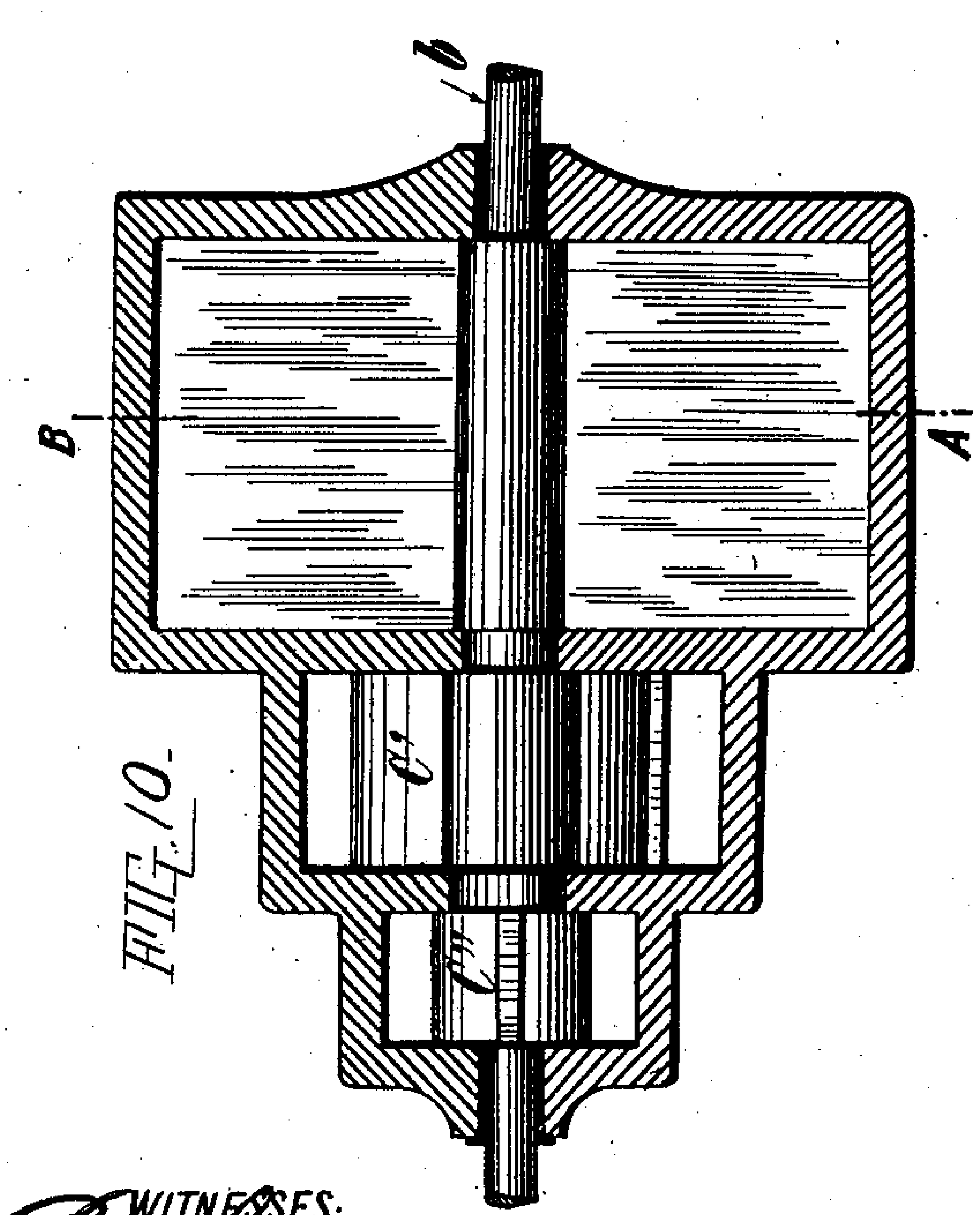



FIG. 10.

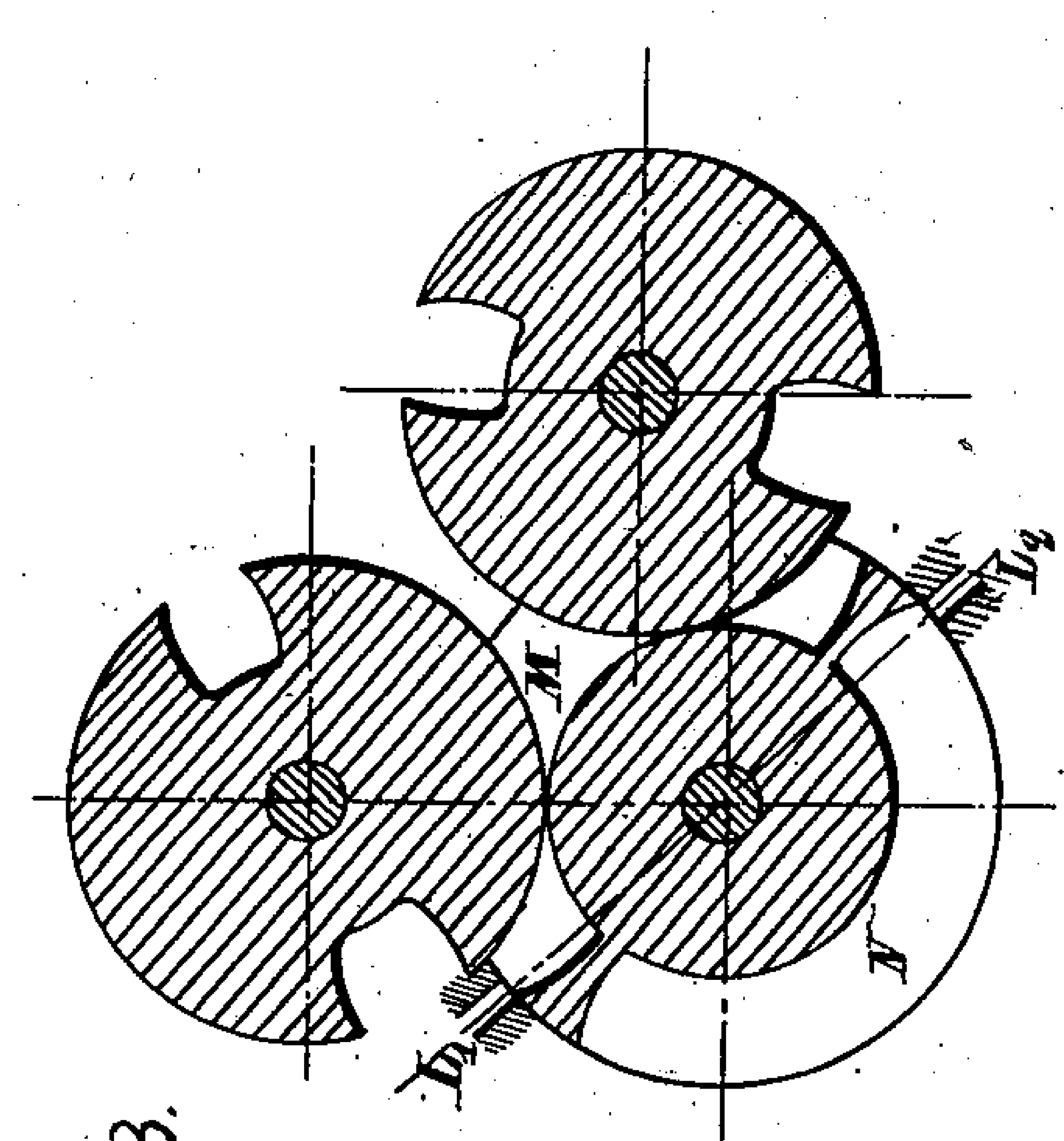



FIG. 8.

WITNESSES:

[signature]

W. R. Edelen.

INVENTOR

Louis J. J. B. Le Rond

BY Philipp Hauer

his ATTORNEY

No. 746,346. PATENTED DEC. 8, 1903.

L. J. J. B. LE ROND.

ROTARY ENGINE.

APPLICATION FILED MAY 26, 1899.

NO MODEL. 5 SHEETS—SHEET 5.

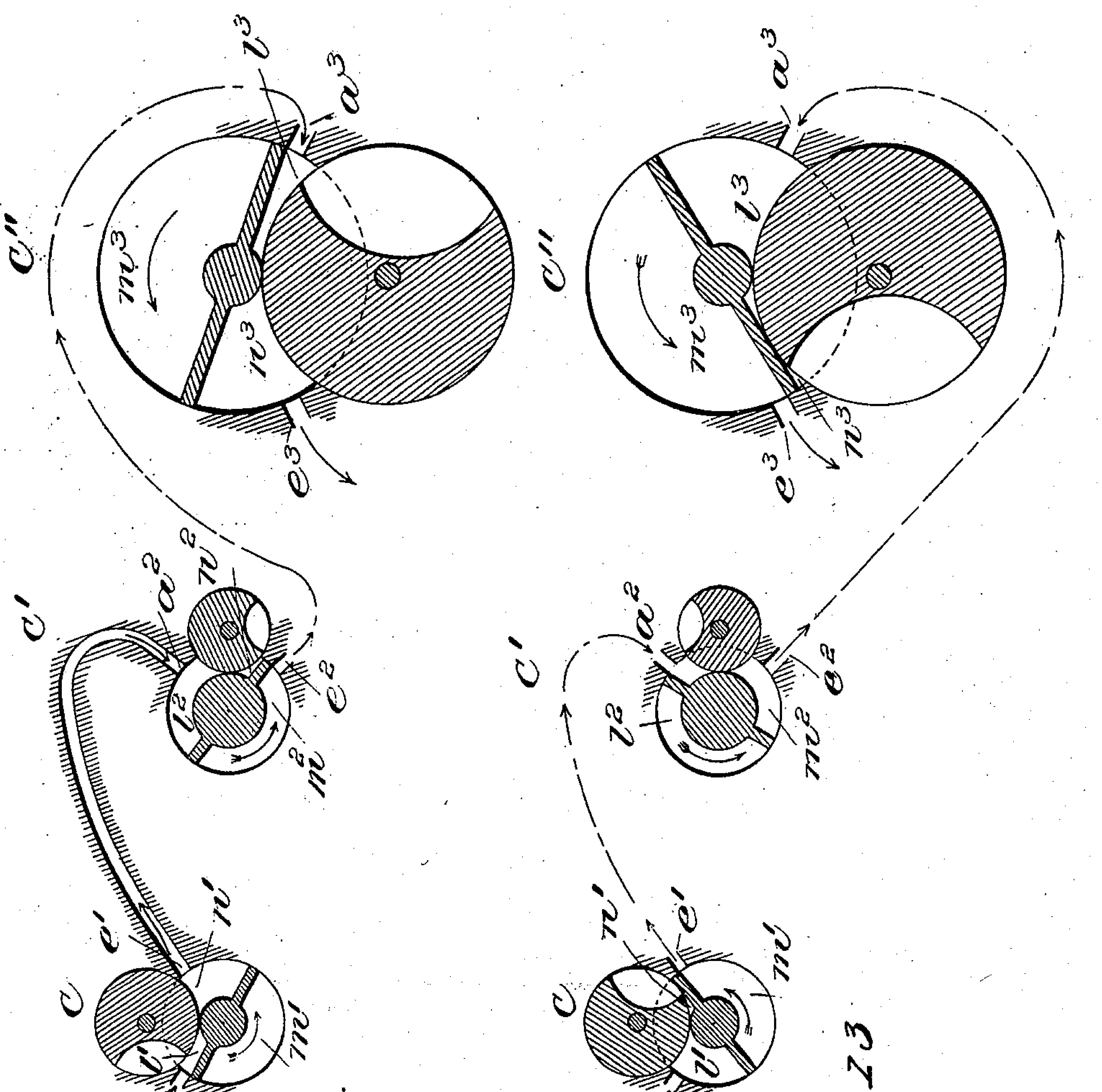



Fig. 12.

Fig. 13.

Witnesses

Inventor

Louis J. J. B. Le Rond,

By Philip Mauro,

Attorney.

No. 746,346. Patented December 8, 1903.

# UNITED STATES PATENT OFFICE.

LOUIS JULES JEAN BAPTISTE LE ROND, OF PARIS, FRANCE.

## ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 746,346, dated December 8, 1903.

Application filed May 26, 1899. Serial No. 718,462. (No model.)

*To all whom it may concern:*

Be it known that I, LOUIS JULES JEAN BAPTISTE LE ROND, a resident of Paris, in the Republic of France, have invented new and useful Improvements in Rotary Engines, which are fully set forth in the following specification.

My invention relates to improvements in multiple-expansion rotary motors or like apparatus in which two or more pistons are fastened to a single shaft rotating in a fixed casing and coöperating with abutments passing through said casing.

My invention consists in the several novel features of construction and operation hereinafter described and which are specifically set forth in the claims hereto annexed.

Figure 1 is a longitudinal section of my engine, the rotary abutments being omitted. Fig. 2 shows a modified construction of my engine. Fig. 3 shows an arrangement for supporting the shafts of my engine. Figs. 4 and 5 illustrate profiles which may be given to pistons and recesses in my engine. Figs. 6 and 7 show my engine complete with means for packing gear-wheels in an oil-box. Figs. 8 and 9 show modifications of my engine. Figs. 10 and 11 show a modified construction of the chambers of my engine. Figs. 12 and 13 illustrate diagrammatically the passage connecting the several cylinders.

My improved apparatus, as will be further explained with reference to the accompanying drawings, comprises a fixed casing forming a series of cylinders, rotary pistons, one in each cylinder, having tores or recesses about its periphery and all fastened to a single shaft, rotary abutments having proper recesses and rotated in unison with the pistons by means of proper gearing, and admission and exhaust ports for the cylinders, so connected that the engine may have a multiple expansion or compression effect.

Fig. 1 shows a series of three chambers C C′ C″. If steam is admitted in C, it will expand more and more as it passes from C to C′ and from C′ to C″, acting in each chamber on the rotary pistons after the known principle of this class of engine, and especially of that as my Patent No. 646,151. In the same way this same device may be used as a thermic motor if, for instance, air be admitted into C and gas or petroleum mixed therewith and the mixture ignited in the intermediate passage between C and C′. The gas or petroleum will burn in the air-draft between C and C′ and the gases of combustion expand in C″. Inversely, if operated as a gas-compressor a gas, such as air, introduced into C″ will be compressed from C″ into C′, then from C′ into C, wherefrom it may flow to a compressed gas or air tank.

Fig. 2 shows another series of three chambers, in which the first, C, is greater in volume than the second, C′, and the third, C″, is greater than both of the former. If, for instance, we suppose the volume of C to be five, the volume of C′ one, and the volume of C″ fifteen, the engine will be fit for being used as a common petroleum or gas motor, the mixed air and gas being admitted in C, compressed in C′, exploded when compressed, and expanded in C″, from whence it escapes.

Every space—such as 1, 2, 3, and 4, Figs. 1 and 2—may be properly connected—for instance, by means of pipe *b*—either together or with a same medium, such as the exhaust-pipe or the steam-box, in order to avoid any unequal pressure on the rotating cylinder that would impose on the journals a strain parallel to its axis.

Figs. 10 and 11 show a disposition of three chambers such as that in Fig. 1, in which inwardly-projecting flanges on the casing form the end walls of the recesses in the pistons.

Figs. 6 and 7 show my engine complete with two chambers, two rotary abutments, gear-wheels 6, connecting the piston-shaft and abutment-shafts, an oil-box 7, inclosing the gear-wheels, and carrying-plates *v*, in which the front ends of the shafts bear.

Figs. 8 and 9 show a modification wherein two rotary abutments are used instead of one without altering the principle of the engine.

Fig. 3 shows an improved arrangement for supporting and centering the shafts of the male and female tores in order to get a perfect parallelism between them. This is obtained by means of cylindrical journals resting in bored bolsters which are formed in the casing itself. Let us suppose the engine has two male tores set on individual shafts $d'$ and $d^2$, $f$ being the main shaft. The end plate $g$ of the casing bears half of the lower part of a bolster $i$, the other half $j$ being formed (or connected) with the cylindrical casing $a$. A single journal with a single cap $k$ constitutes a very simple and effective support for shaft $d'$. The same arrangement may be used at both ends and for all of the male tore-shafts, and the caps of the bolsters may be cast solid with the outer casings, which may be used for the male tores.

Figs. 4 and 5 are modified profiles for the pistons and recesses; but, in fact, any profiles may do without altering the engine under this only condition that during rotation they insure between both piston and abutment a steam-tight joint. It will be noticed that it is also necessary to enable one to dispense with a distributing slide or valve that the angle between any two successive pistons be smaller than the angle between any inlet-port and the corresponding exhaust-port. If besides these two conditions a series of chambers be used through which the fluid successively passes by means of permanently-open ports, any style of compression or expansion or compound compression and expansion may be obtained without using any distributing slide or valve. Of course distributing valves or slides may also be used without altering the engine.

Figs. 12 and 13 show diagrammatically the passages connecting the admission and exhaust ports of the several cylinders C C' C''. In the position of the parts as shown in Fig. 1 admission of gaseous explosive mixture is commencing through passage $a'$ and space $l'$, space $m'$ is filled with the mixture, and the mixture from space $n'$ is being forcibly ejected through passage $e'$ and compressed in space $l^2$ of cylinder C', space $m^2$ (wherein the mixture is exploded) is discharging through passage $c^2$ into space $l^3$ of cylinder C'', (where power is exerted to rotate the shaft carrying the pistons,) and space $n^3$ is discharging the spent products of combustion through exhaust-passage $e^3$. Fig. 13 illustrates position of the parts at the conclusion of admission through passage $a'$ of cylinder C, as will be apparent.

When my invention is embodied in an explosive-engine, such as shown in Fig. 2, the two spaces $l^2$ $m^2$ of cylinder C, Figs. 12 and 13, are each smaller than the corresponding spaces of cylinder C', so that the volume of explosive gas admitted to the former is compressed in the latter, as already explained. In the case of a multiple-expansion steam-engine (shown in Fig. 1) spaces $l^2$ and $m^2$, Figs. 12 and 13, would be larger than the corresponding spaces of cylinder C', so that the steam from cylinder C would expand in cylinder C' and further expand in cylinder C''. The passage of the motive fluid and general construction are, however, substantially the same in both cases.

What I claim is—

1. In a multiple-expansion rotary motor or like apparatus, a fixed casing forming a series of tandem-arranged cylinders of different diameters, fluid admission and exhaust ports for each cylinder, passages connecting the exhaust-port of one cylinder with the admission-port of the next cylinder, a series of separated and corresponding pistons within said cylinders, each piston having a peripheral recess divided into chambers, a single shaft securing all the pistons together, and rotary abutments coöperating with the recesses or pockets in said pistons, substantially as set forth.

2. In a multiple-expansion rotary motor or like apparatus, a fixed casing longitudinally divided and forming a series of tandem-arranged cylinders of different diameters, a series of pistons within the cylinders and of corresponding diameters, each piston having a peripheral recess divided into chambers, the chambers of the piston of a larger diameter being larger than the chambers of the piston of a smaller diameter, admission and exhaust ports for the cylinders and a passage connecting the exhaust-port of one cylinder with the admission-port of the next cylinder, a single shaft securing all the pistons together and rotary abutments coöperating with the recesses in said pistons, substantially as set forth.

3. In a multiple-expansion rotary motor or like apparatus, a fixed casing having semicylindrical journal-bearings formed integral with said casing, caps for said journal-bearings, said casing forming a series of tandem-arranged cylinders of different diameters, fluid admission and exhaust ports for each cylinder, passages connecting the exhaust-port of one cylinder with the admission-port of the next cylinder, a series of separated and corresponding pistons within said cylinders, each piston having a peripheral recess divided into chambers, a single shaft securing all the pistons together, and abutments coöperating with the recesses or pockets in said pistons, substantially as set forth.

4. In a rotary motor, or like apparatus, a fixed casing forming a series of cylinders, a series of motive pistons within said cylinders, admission and exhaust ports for the cylinders respectively and pressure-equalizing passages connecting the spaces between the ends of the several pistons and the cylinders.

5. In a rotary engine or like apparatus, a fixed casing forming a series of cylinders arranged tandemwise, a series of motive pistons within the said chambers respectively, each piston having recesses or chambers about its periphery, admission and exhaust ports for the cylinders respectively, and a passage connecting the exhaust-port of the first cylin-

der with the admission-port of the next cylinder, a single shaft to which all of the pistons are secured, rotary abutments for the pistons projecting through openings in the casing and engaging in the chambers of the pistons, and pressure-equalizing passages connecting the spaces between the ends of the several pistons and the casing.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

LOUIS JULES JEAN BAPTISTE LE ROND.

Witnesses:
EMILE LEDUC,
EDWARD P. MACLEAN.